earth. Any delay of a wave due to the propagation of the wave in the protected unit is generally due to the wave impedance being frequency dependent and/or the length of the power flow or current path in the protected unit.

[0009] A further a concern of the present invention is to provide a method in a power system, which method may facilitate or enable sensing a fault in a protected unit included in a power system, which protected unit is adapted to, under normal or non-faulted operation conditions, convey power from a first position in the protected unit to a second position, different from the first position, in the protected unit, or vice versa, via a plurality of conductors, wherein on a condition that a fault occurs in the protected unit at least one travelling wave is generated in the protected unit. The method may facilitate or enable reducing or even eliminating the number of unwarranted interruptions in power flow in the power system, e.g. by tripping of circuit breakers in the power system, due to false detections of faults in the protected unit.

[0010] To address at least one of these concerns and other concerns, a method and a processing module in accordance with the independent claims are provided. Preferred embodiments are defined by the dependent claims.

[0011] In the following, the protected unit will often be referred to by an example of it being constituted by or including a transmission line, which may be a multi-conductor transmission line, i.e. a transmission line comprising a plurality of conductors or phases. However, it is to be understood that the protected unit in general may be included in or be any part or component of the power system, for example a transmission line, a transformer, a generator and/or a transformer station busbar. In the following, even if reference is made to an example where the protected unit is constituted by or including a transmission line, it is to be understood that the same or similar principles apply to other examples such as mentioned above where the protected unit is not constituted by or including a transmission line. Hence, the term 'transmission line' or 'line' as used herein should be construed broadly, and is not intended to limit the scope.

[0012] Attenuation and distortion of waves due to their propagation along a current path in the protected unit or in the transmission line result in a decrease in amplitude and elongation of the waves. The attenuation is generally due to loss of energy, e.g. in the resistances of the protected unit conductors and earth. The distortion is generally due to the wave impedance being frequency dependent.

[0013] In the event of a fault occurring in a transmission line, transients that propagate along the transmission line as waves are created. Each wave may be a composite of frequencies, ranging from a few kHz to several MHz, having a fast rising front and a slower decaying tail. Composite waves may travel at a fraction or close to the speed of light in vacuum away from the fault location toward line ends. For example in DC cables, waves may travel at speeds of about one fourth to one third of the speed of light in vacuum. The waves continue to travel throughout the power system until an equilibrium state is reached.

[0014] According to a first aspect of the present invention, there is provided a method in a power system which includes a protected unit adapted to convey power from a first position in the protected unit to a second position in the protected unit, or vice versa, via a plurality of conductors. The first position may be different from the second position. On a condition that a fault occurs in the protected unit, at least one travelling wave may be generated in the protected unit, wherein any distortion, attenuation and/or delay of the waveform of a wave due to propagation of the wave in the protected unit can be modeled by means of a propagation function. The method comprises determining a first travelling wave current in the first position and a second travelling wave current in the second position. A first travelling wave differential current is determined based on a comparison between the determined first travelling wave current or the second travelling wave current and an estimation of the first travelling wave current or the second travelling wave current, respectively. Estimation of the first travelling wave current or the second travelling wave current is carried out by applying the propagation function to the second travelling wave current or to the first travelling wave current, respectively. The first travelling wave differential current has a plurality of modes which correspond to respective ones of the plurality of conductors. A second travelling wave differential current is determined by means of, based on the propagation function, adjusting at least one of magnitude and phase of the first travelling wave differential current such that all modes attain equal or increasingly equal modal characteristics.

[0015] A method according to the first aspect may for example be utilized in a protection algorithm based on travelling-wave based differential protection, which is capable of sensing a fault in the protected unit.

[0016] According to the first aspect, a first travelling wave differential current is determined by means of a comparison between the determined first travelling wave current or the second travelling wave current, and an estimation of the first travelling wave current or the second travelling wave current, respectively, where the estimation of the first travelling wave current or the second travelling wave current is carried out by applying the propagation function to the second travelling wave current or to the first travelling wave current, respectively. Hence, a travelling wave differential current is determined for one of the first and second positions by comparing a travelling wave current determined in that position with an estimation of a travelling wave current in that position, which has been estimated based on a travelling wave current in the other one of the first and second positions and the propagation function, which takes into account and/or introduces the effect of any distortion, attenuation and/or delay of the waveform of a wave due to propagation of the wave in the protected unit or transmission line. The comparison between the determined first travelling wave current or the second travelling wave current, and the estimation of the first travelling wave current or the second travelling wave current, respectively, may for example include determining a difference between the determined first travelling wave current or the second travelling wave current, and the estimation of the first travelling wave current or the second travelling wave current, respectively.

[0017] By utilizing the propagation function in the estimation of the first travelling wave current or the second travelling wave current, any non-negligible distortion, attenuation and/or delay of the waveform of a wave due to the propagation of the wave in the protected unit or transmission line may be accounted for. Thereby, a relatively high reliability and/or accuracy may be achieved in fault sensing based on the first travelling wave differential current, not only for protected unit configurations such as OHL where